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1. Your reference P24532/ACO/MVE/JAL 06SEP99 E474510-1 D02984
F01/7700 0.00 - 9920935.5

2. Patent application number 9920935.5
(The Patent Office will fill in this part)

3. Full name, address and postcode of the or of each applicant (underline all surnames)
e2-TECH Limited
Stoneywood Park North
Dyce
ABERDEEN
AB21 7EA

Patents ADP number (if you know it) 07734395001
If the applicant is a corporate body, give the country/state of its incorporation United Kingdom

4. Title of the invention "Apparatus for and a Method of Anchoring a First Conduit to a Second Conduit"

5. Name of your agent (if you have one) Murgitroyd & Company
"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)
373 Scotland Street
Glasgow
G5 8QA

Patents ADP number (if you know it) 1198013

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country	Priority application number (if you know it)	Date of filing (day / month / year)
---------	--	-------------------------------------

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing (day / month / year)
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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d)) Yes

1

1 "Apparatus for and Method of Anchoring a First Conduit
2 to a Second Conduit"
3

4 The present invention relates to an apparatus for and a
5 method of anchoring a first conduit to a second
6 conduit, the apparatus and method particularly, but not
7 exclusively, using an inflatable device to provide an
8 anchor.
9

10 A borehole is conventionally drilled during the
11 recovery of hydrocarbons from a well, the borehole
12 typically being lined with a casing. Casings are
13 installed to prevent the formation around the borehole
14 from collapsing. In addition, casings prevent unwanted
15 fluids from the surrounding formation from flowing into
16 the borehole, and similarly, prevents fluids from
17 within the borehole escaping into the surrounding
18 formation.
19

20 Boreholes are conventionally drilled and cased in a
21 cascaded manner; that is, casing of the borehole begins
22 at the top of the well with a relatively large outer
23 diameter casing. Subsequent casing of a smaller
24 diameter is passed through the inner diameter of the
25 casing above, and thus the outer diameter of the

1 drill pipe, rods, coiled tubing, a wireline or the
2 like).

3

4 Lengths of expandable casing are coupled together
5 (typically by threaded couplings) to produce a casing
6 string. The casing string is inserted into the
7 borehole in an unexpanded state and is subsequently
8 expanded using the expander device, typically using a
9 substantial force to facilitate the expansion process.
10 However, the unexpanded casing string requires to be
11 anchored either at, or near, an upper end or a lower
12 end thereof during the expansion process to prevent
13 undue movement. This is because when the casing string
14 is in an unexpanded state, an outer surface of the
15 casing string does not contact the surrounding borehole
16 formation (until at least a portion of the casing has
17 been radially expanded), and thus there is no inherent
18 initial anchoring point.

19

20 Slips are conventionally used to temporarily anchor the
21 unexpanded casing to the borehole during the expansion
22 process. Slips are generally wedge-shaped, steel,
23 hinged sections which provide a temporary anchor when
24 used. Slips are actuated whereby the wedge-shaped
25 sections engage with the surrounding borehole formation
26 or a casing or liner section.

27

28 However, the mechanical configuration of slips often
29 suffers from damage of the casing or liner. In some
30 cases, the damage causes the slip to fail due to a loss
31 of mechanical grip. Slip-type devices in open-hole
32 engaging formation are often prone to slippage also.

33

34 According to a first aspect of the present invention,
35 there is provided an apparatus for anchoring a first
36 conduit to a second conduit, the apparatus comprising

5

1 string or the like to be passed through the inflatable
2 device in use.

3

4 Optionally, the inflatable device includes an expander
5 device. The expander device is optionally
6 telescopically coupled to the inflatable device, so
7 that when the expander device is moved a certain
8 distance, the inflatable device is deflated and
9 subsequently moves with the expander device.

10

11 Alternatively, the expandable device may be releasably
12 attached to the inflatable device, typically using a
13 latch mechanism.

14

15 The inflatable device may be located within the
16 expandable conduit. Alternatively, the inflatable
17 device may be coupled at or near an upper end of the
18 expandable conduit, or at or near a lower end of the
19 expandable conduit. The inflatable device may be
20 coupled to the expandable conduit using a suitable
21 connection.

22

23 The inflatable device is typically inflated to expand
24 the expandable conduit whereby the expandable conduit
25 contacts the second conduit, thereby providing an
26 anchor. In this embodiment, the expandable conduit is
27 optionally provided with a slotted portion to
28 facilitate expansion. This is advantageous as the
29 contact between the expandable conduit and the second
30 conduit provides the anchor, and forces applied to the
31 expandable conduit are mainly channelled into the
32 second conduit via the expandable conduit and not the
33 inflatable device.

34

35 Alternatively, the inflatable device is inflated
36 whereby a portion thereof directly contacts the second

1 the expandable conduit (eg using drill pipe, rods,
2 coiled tubing, a wireline or the like).

3

4 Optionally, the inflatable device may act as a seal
5 whereby fluid pressure can be applied below the seal.

6

7 Embodiments of the present invention shall now be
8 described, by way of example only, with reference to
9 the accompanying drawings, in which:-

10 Figs 1a to 1d are successive stages in anchoring
11 and expanding an expandable conduit within a
12 second conduit using a first embodiment of an
13 inflatable device;

14 Figs 2a to 2d are successive stages in anchoring
15 and expanding an expandable conduit within a
16 borehole to tie back the expandable conduit to a
17 casing using a second embodiment of an inflatable
18 device; and

19 Figs 3a to 3d are successive stages in anchoring
20 and expanding an expandable conduit within a
21 second conduit using a third embodiment of an
22 inflatable device.

23

24 Referring to Fig. 1, there is shown in sequence (Figs
25 1a to 1d) successive stages of anchoring an expandable
26 conduit 10 to a casing 12 provided in a borehole (not
27 shown), the borehole typically being drilled to
28 facilitate the recovery of hydrocarbons. The
29 expandable conduit 10 is typically an expandable liner,
30 but any type of expandable conduit may be used.

31

32 The borehole is conventionally lined with a casing to
33 prevent the formation around the borehole from
34 collapsing and also to prevent unwanted fluids from the
35 surrounding formation from flowing into the borehole,
36 and similarly, prevents fluids from within the borehole

9

1 Referring to Fig. 1b, the inflatable device 14 is
2 inflated to expand the inflatable annular balloon-type
3 portion 14b. As the balloon-type portion 14b expands,
4 an anchor portion 10a of the conduit 10 is also
5 expanded. The anchor portion 10a is expanded by the
6 inflatable device 14 until it contacts the casing 12,
7 as shown in Fig. 1b. This contact between the anchor
8 portion 10a of the expandable conduit 10 and casing 12
9 provides an anchor point and/or a seal between the
10 expandable conduit 10 and the casing 12. The outer
11 surface of the anchor portion 10a may be suitably
12 profiled (eg ribbed) or coated with a friction and/or
13 sealing material to enhance the grip of the conduit 10
14 on the casing 12.

15
16 It should be noted that forces applied to the conduit
17 10, eg by subsequent movement of the conduit 10, that
18 is by pushing or pulling on the conduit 10 for example,
19 will be mainly transferred to the casing 12 via the
20 anchor point and not through the inflatable device 14.
21 This is advantageous as it reduces the risk of damage
22 to the inflatable device 14. Additionally, this also
23 reduces the risk of damage to the casing 12 which may
24 have occurred where a conventional slip was used.
25 Also, conventional slips may lose their grip on the
26 casing 12 where damage ensues or the casing 12 is weak.
27 Transferring substantially all of the forces directly
28 to the casing 12 via the anchor point obviates these
29 disadvantages.

30
31 The expander device 16 can then be pulled through the
32 expandable conduit 10 to radially expand the conduit
33 10, as shown in Fig. 1c. The expander device 16 can be
34 propelled through the conduit 10 in any conventional
35 manner. In Fig. 1, the expander device 16 is pulled
36 through the conduit 10 using a drill pipe 20 which is

11

1 surrounding formation and no rig is required. With the
2 inflatable device 14 configured as an annular ring 14r,
3 substantially full bore access is still possible.

4

5 It should be noted that the method described with
6 reference to Fig. 1 is intended to expand the
7 expandable conduit 10 in a single pass of the expander
8 device 16 through the expandable conduit 10, but
9 multiple passes and/or expansions are possible.

10

11 Referring to Fig. 2, there is shown in sequence (Figs
12 2a to 2d) successive stages of hanging an expandable
13 conduit 30 off a casing 32 (ie tying back a liner), the
14 expandable conduit 30 typically comprising an
15 expandable liner and being used to line or case a lower
16 portion of a borehole 34, the borehole 34 typically
17 being drilled to facilitate the recovery of
18 hydrocarbons. The lower portion of the borehole 34 has
19 not been lined/cased, wherein the upper portion of the
20 borehole 34 has been lined with an existing casing or
21 liner 36.

22

23 In the embodiment shown in Fig. 2, the expandable
24 conduit 30 is provided with a friction and/or sealing
25 material 38 on an outer surface thereof. The function
26 of the friction and/or sealing material 38 is to
27 provide a (friction and/or sealing) coupling between
28 the expandable conduit 30 and the existing liner or
29 casing 36. The friction and/or sealing material 38 may
30 also provide a seal between the lower (unlined) and
31 upper (lined) portions of the borehole 34.

32

33 Referring to Fig. 2, an inflatable device 40, which has
34 an expander device 42 releasably attached thereto, is
35 positioned within the expandable conduit 30 before the
36 conduit 30 is inserted into the borehole 34. The

13

1 inflated to expand the inflatable annular balloon-type
2 portion 40b. As the balloon-type portion 40b expands,
3 the expandable portion 44 also expands. As can be seen
4 in Fig. 2b, the longitudinal slots 48 widen as the
5 portion 44 expands. Portion 44 acts as an anchor for
6 the casing 30 and is expanded until it contacts the
7 borehole 34, as shown in Fig. 2b. This contact between
8 portion 44 and the borehole 34 provides an anchor point
9 and/or a seal between the expandable conduit 30 (to
10 which portion 44 is releasably attached) and the
11 borehole 34.

12

13 As with the previous embodiment, the expander device 42
14 is then pulled through the expandable conduit 30 to
15 radially expand the conduit 30, as shown in Fig. 2c.
16 The expander device 42 can be propelled through the
17 conduit 30 in any conventional manner. In Fig. 2, the
18 expander device 42 is pulled through the conduit 30
19 using a drill pipe 52 which is attached to the expander
20 device 42 in any conventional manner.

21

22 As the expander device 42 is pulled upwards, the upward
23 movement thereof is stopped after a predetermined time
24 or distance, at which point the expander device 42 is
25 lowered until a coupling between the expander device 42
26 and the inflatable device 40 latches. As with the
27 previous embodiments, the inflatable annular balloon-
28 type portion 40b is automatically deflated and further
29 upward movement of the expander device 42 causes the
30 inflatable device 40 also to move upward, as shown in
31 Fig. 2d. It should be noted that the upward movement
32 of the expander device 42 should only be stopped once a
33 sufficient length of conduit 30 has been expanded to
34 provide a sufficient anchor.

35

36 It should also be noted that the portion 44 is no

15

1 An inflatable device 84 is releasably attached to a
2 lower end 801 of the expandable conduit 80 before the
3 conduit 80 is inserted into the casing 82. The
4 expander device 86 is located within the lower end 801
5 of the conduit 80, the lower end 801 being expanded to
6 accommodate the expander device 86. Similar to the
7 previous embodiment, the inflatable device 84 has the
8 expander device 86 releasably coupled thereto via a
9 coupling 88. Otherwise, the inflatable device 84 and
10 the expander device 86 are substantially the same as
11 the previous embodiments.

12
13 Referring to Fig. 3a, the casing 80 with the inflatable
14 device 84 attached thereto and the expander device 86
15 located therein is run into the hole to the required
16 setting depth. It will be appreciated that although
17 Figs 3a to 3d show the inflatable device 84 releasably
18 attached to the lower end 801 of the conduit 80, the
19 inflatable device 84 may be releasably attached at, or
20 near, an upper end of the conduit 80.

21
22 The inflatable device 84 may be of any suitable
23 configuration, but is typically a device which has an
24 inflatable annular balloon-type portion 84b which is
25 mounted on an annular ring 84r. The annular ring 84r
26 allows a string, wireline or the like to be passed
27 through the inflatable device 84 as required. This is
28 particularly advantageous where the inflatable device
29 84 and/or the expander device 86 are positioned at the
30 upper end of the conduit 80.

31
32 Referring to Fig. 3b, the inflatable device 84 is
33 inflated to expand the inflatable annular balloon-type
34 portion 84b. As the balloon-type portion 84b expands,
35 it contacts the casing 82, thus providing an anchor
36 between the conduit 80 and the casing 82. This contact

17

1 The expander device 86 is continually pulled upwards
2 towards the surface until the conduit 80 is fully
3 expanded to contact the casing 82. Thereafter, the
4 inflatable device 84 and the expander device 86 may be
5 removed from the borehole at the surface.

6
7 Anchoring and expanding the conduit 80 in this way has
8 the same advantages as in the previous embodiments.

9
10 The method and apparatus described herein may be used
11 for a plurality of different downhole functions
12 relating to the use of expandable conduit. For
13 example, they may be used where the original liner or
14 casing requires to be repaired due to damage or the
15 like by overlaying the damaged portion with a portion
16 of expandable conduit. They may also be used to tie
17 back to the liner or casing, as described herein.

18
19 Thus, there is provided in certain embodiments an
20 apparatus and method of anchoring an expandable conduit
21 to a second conduit. The apparatus and method of
22 certain embodiments provide numerous advantages over
23 conventional mechanical anchoring devices, such as
24 slips, particularly by reducing the potential damage to
25 conduits which slips may cause. Certain embodiments of
26 apparatus and methods involve the use of an inflatable
27 device which can either be a) attached directly at, or
28 near, the top or bottom of the expandable conduit, or
29 b) placed within the top or bottom of the expandable
30 conduit. In a), anchoring forces are generated as a
31 result of friction between the inflatable device and
32 the second conduit, the forces being passed into the
33 conduit via the inflatable device. In b), anchoring
34 forces are generated by friction between an outer
35 surface of the expandable conduit and the second
36 conduit, the forces being substantially passed into the

FIG. 2

HydraForm²

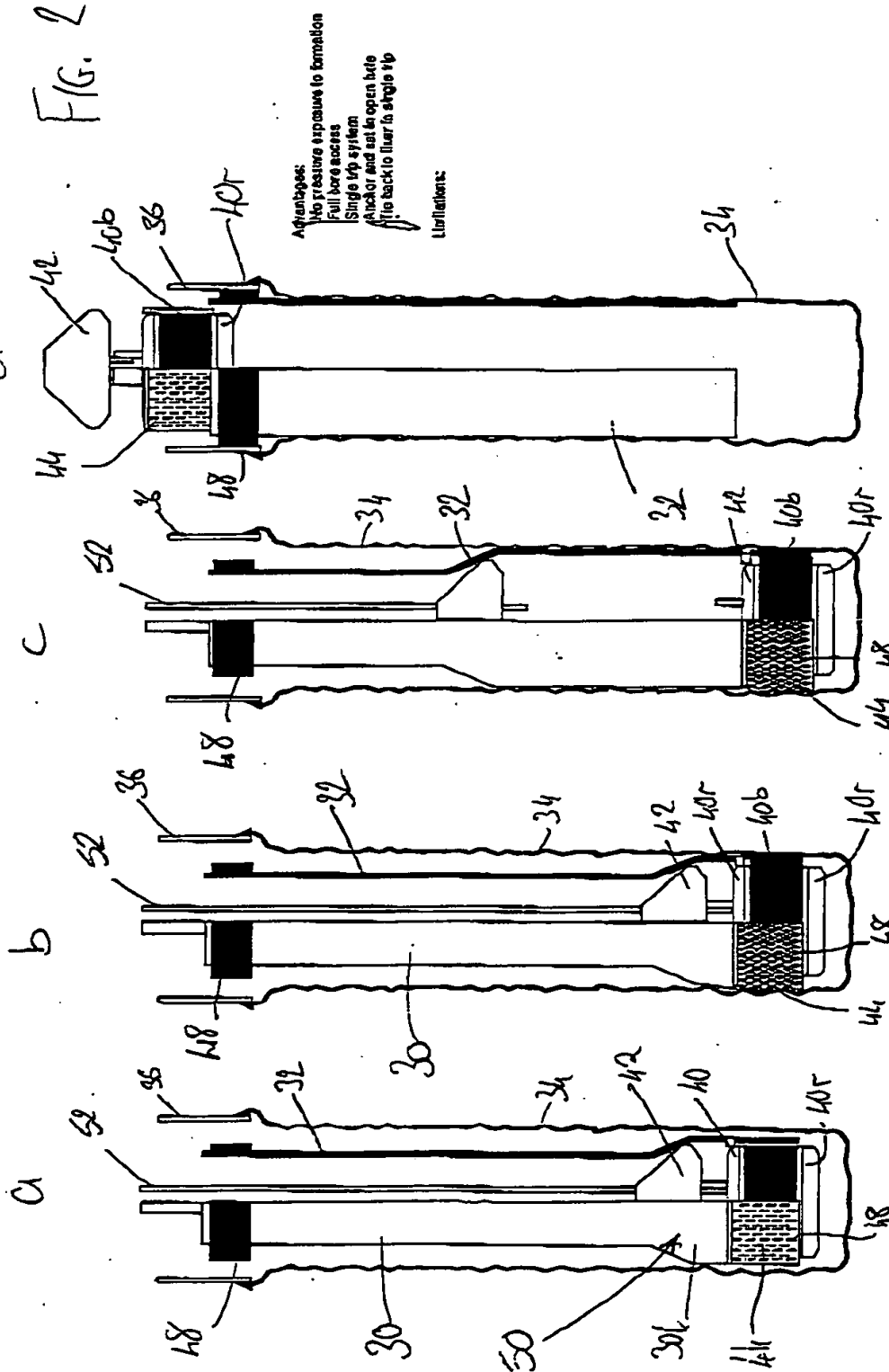


FIG. 2

Advantages:
No reactive exposure to formation
Full bore access
Single trip system
Anchor and set in open hole
Pull back to floor in single trip

Utilizations:

FIG. 2 is a schematic diagram of the HydraForm² system. The diagram shows a wellbore (30) with a packer (44) and a plug (48) at the bottom. The packer (44) is moved up (42) to expose the plug (48). The plug (48) is then moved up (42) to expose the wellbore (30). The packer (44) and plug (48) are then moved back down (40) to the bottom of the wellbore (30). The diagram is labeled with various reference numerals (18, 30, 32, 34, 36, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194, 196, 198, 200, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 224, 226, 228, 230, 232, 234, 236, 238, 240, 242, 244, 246, 248, 250, 252, 254, 256, 258, 260, 262, 264, 266, 268, 270, 272, 274, 276, 278, 280, 282, 284, 286, 288, 290, 292, 294, 296, 298, 300, 302, 304, 306, 308, 310, 312, 314, 316, 318, 320, 322, 324, 326, 328, 330, 332, 334, 336, 338, 340, 342, 344, 346, 348, 350, 352, 354, 356, 358, 360, 362, 364, 366, 368, 370, 372, 374, 376, 378, 380, 382, 384, 386, 388, 390, 392, 394, 396, 398, 400, 402, 404, 406, 408, 410, 412, 414, 416, 418, 420, 422, 424, 426, 428, 430, 432, 434, 436, 438, 440, 442, 444, 446, 448, 450, 452, 454, 456, 458, 460, 462, 464, 466, 468, 470, 472, 474, 476, 478, 480, 482, 484, 486, 488, 490, 492, 494, 496, 498, 500, 502, 504, 506, 508, 510, 512, 514, 516, 518, 520, 522, 524, 526, 528, 530, 532, 534, 536, 538, 540, 542, 544, 546, 548, 550, 552, 554, 556, 558, 560, 562, 564, 566, 568, 570, 572, 574, 576, 578, 580, 582, 584, 586, 588, 590, 592, 594, 596, 598, 600, 602, 604, 606, 608, 610, 612, 614, 616, 618, 620, 622, 624, 626, 628, 630, 632, 634, 636, 638, 640, 642, 644, 646, 648, 650, 652, 654, 656, 658, 660, 662, 664, 666, 668, 670, 672, 674, 676, 678, 680, 682, 684, 686, 688, 690, 692, 694, 696, 698, 700, 702, 704, 706, 708, 710, 712, 714, 716, 718, 720, 722, 724, 726, 728, 730, 732, 734, 736, 738, 740, 742, 744, 746, 748, 750, 752, 754, 756, 758, 760, 762, 764, 766, 768, 770, 772, 774, 776, 778, 780, 782, 784, 786, 788, 790, 792, 794, 796, 798, 800, 802, 804, 806, 808, 810, 812, 814, 816, 818, 820, 822, 824, 826, 828, 830, 832, 834, 836, 838, 840, 842, 844, 846, 848, 850, 852, 854, 856, 858, 860, 862, 864, 866, 868, 870, 872, 874, 876, 878, 880, 882, 884, 886, 888, 890, 892, 894, 896, 898, 900, 902, 904, 906, 908, 910, 912, 914, 916, 918, 920, 922, 924, 926, 928, 930, 932, 934, 936, 938, 940, 942, 944, 946, 948, 950, 952, 954, 956, 958, 960, 962, 964, 966, 968, 970, 972, 974, 976, 978, 980, 982, 984, 986, 988, 990, 992, 994, 996, 998, 1000).

Step 4
Pull packer, delta,
pull out of hole

Step 3
Pull up to continuously expand
with cone.

Step 2
Inflate packer to expand
anchor section

Step 1
Pull to setting depth

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Mr. Jones

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NEW
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OF
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HydrateFlexTM

Advantages:
No pressure exposure to formation
Full bore access
Single trip system
Anchor and set in cased hole
Use back liner in single trip

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Step 4
RIM, latch packer, deflate,
pull out of hole

Step 3
Pick up to continuously expand
with cone

Step 2

Initiate packet to anchor line!

Step 1: Find selling depth

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